

Methods for Estimating Emissions Avoided by Renewable Energy and Energy Efficiency

Findings from EPA W.A. 204

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Objective

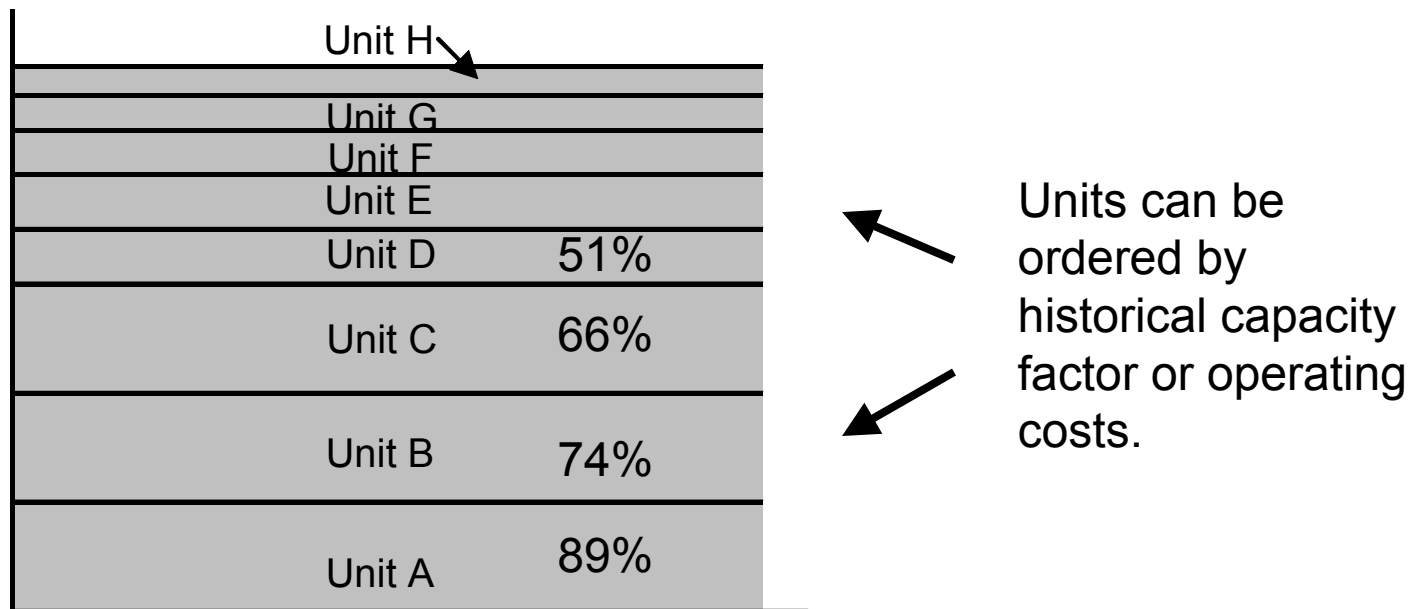
Review and compare the best methods of estimating displaced emissions, which do not involve dispatch modeling.

Methods Reviewed

- Match seasonal bid stacks to loads to identify marginal units
- Use a capacity factor-based rule to allocate reduced generation to units
- Calculate hourly “load-following” emission rates rate from historical CEMS data

Matching Bid Stacks to Loads

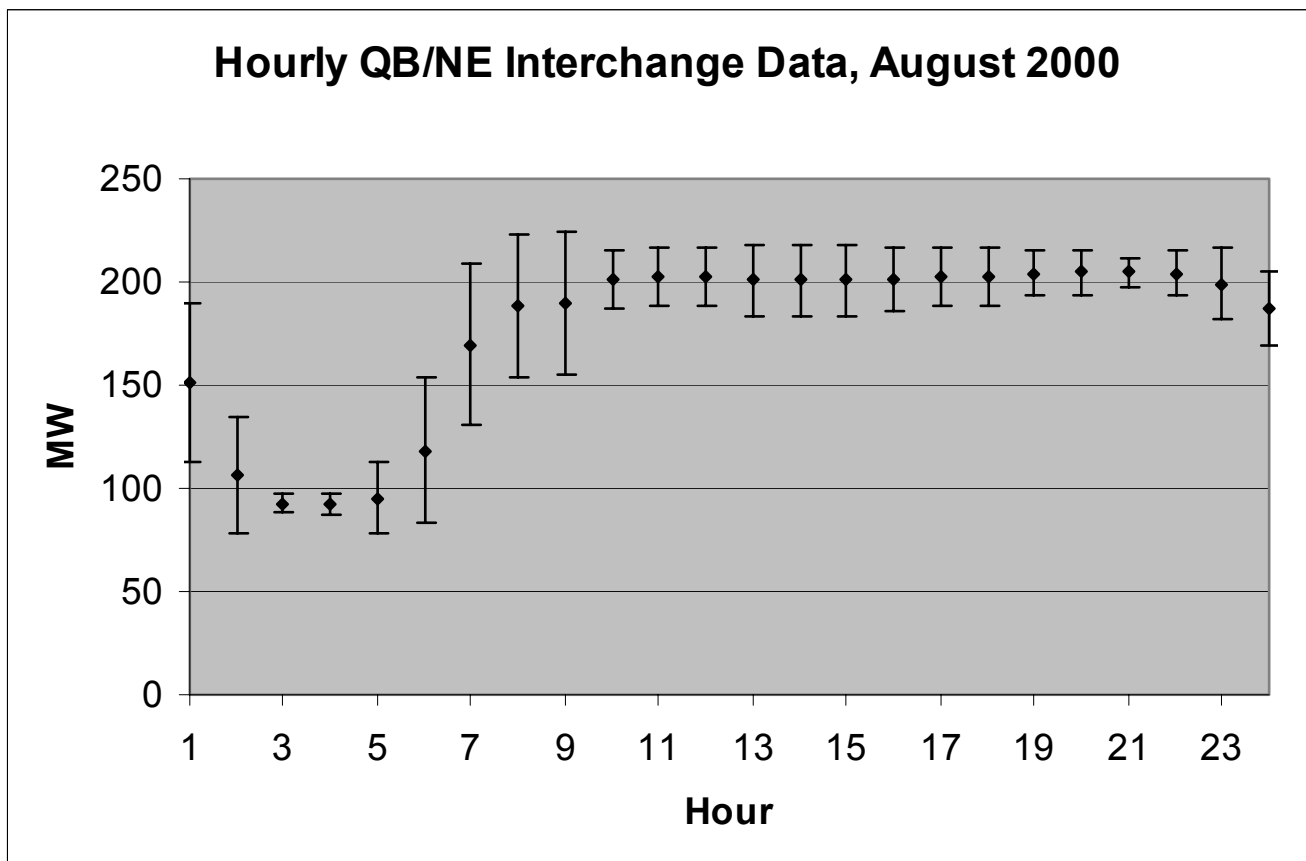
The goal is to create bid stacks representing common seasonal conditions.



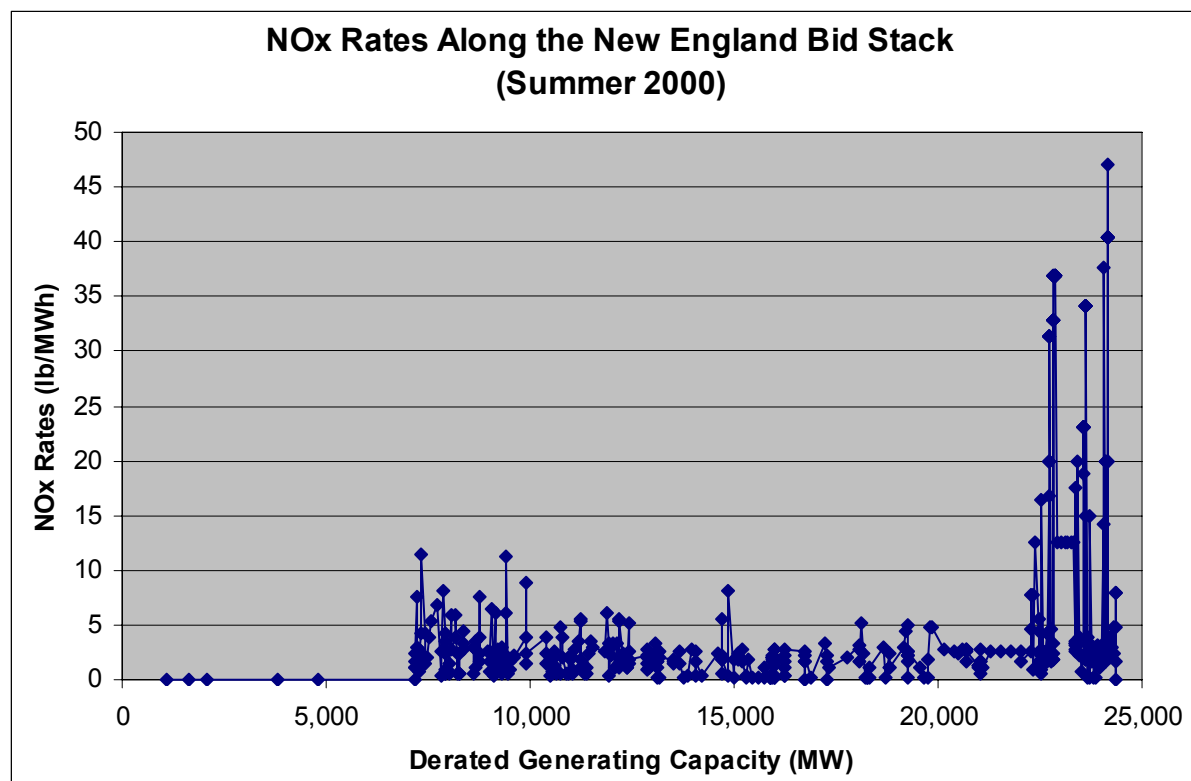
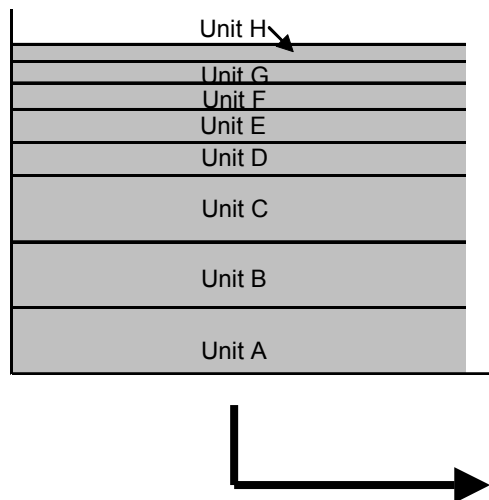
But how do you factor in energy transfers?

Adjust for Major Energy Transfers

Review historical transfer data, and summarize common seasonal transfer patterns.

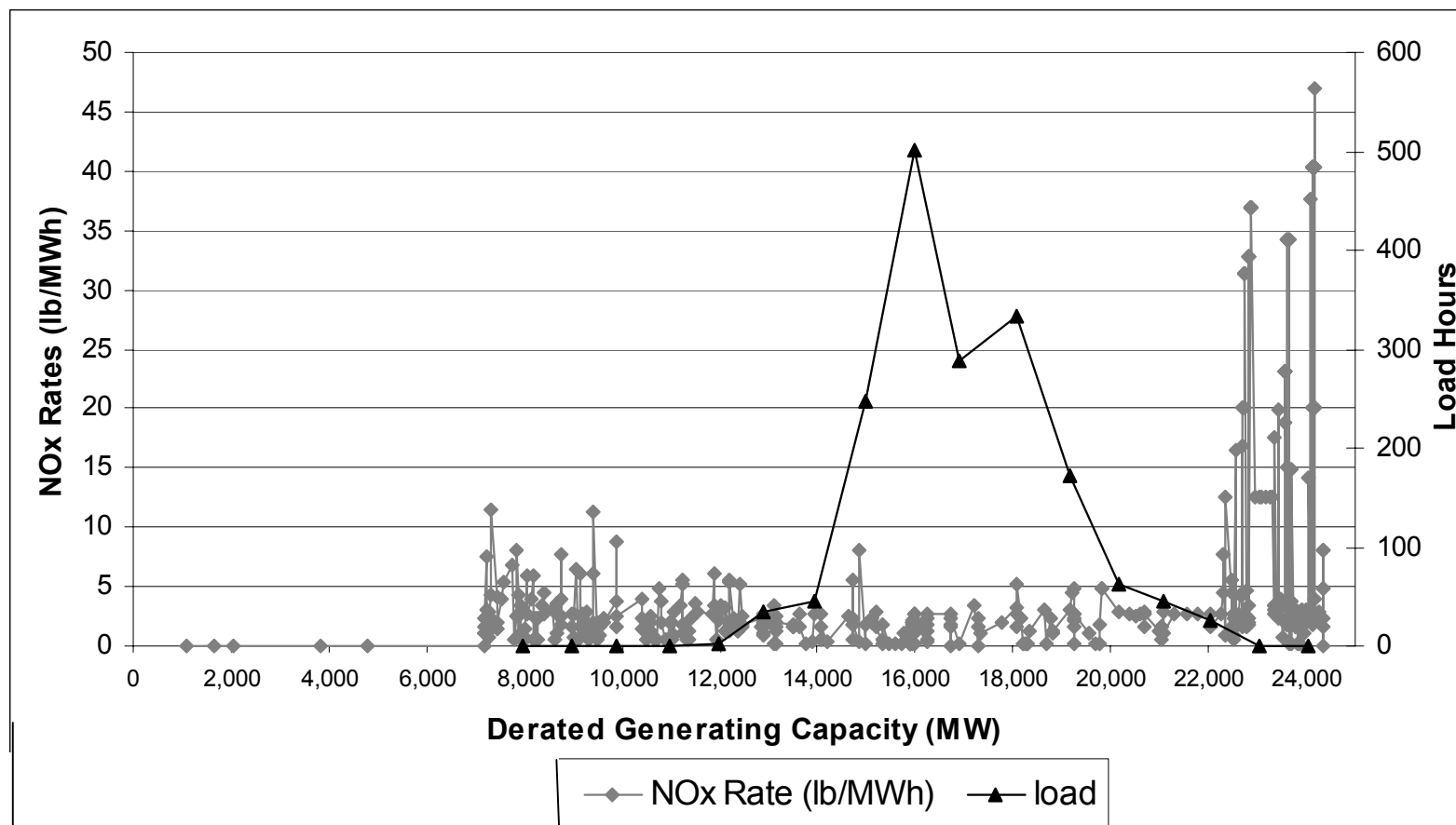


Match Capacity to Loads (1)



Match Capacity to Loads (2)

Summer peak loads compared to bid stack NOx rates.

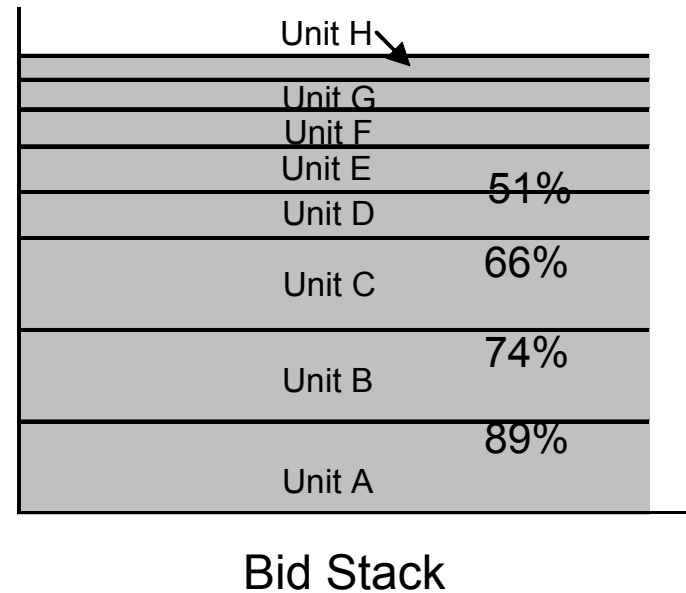
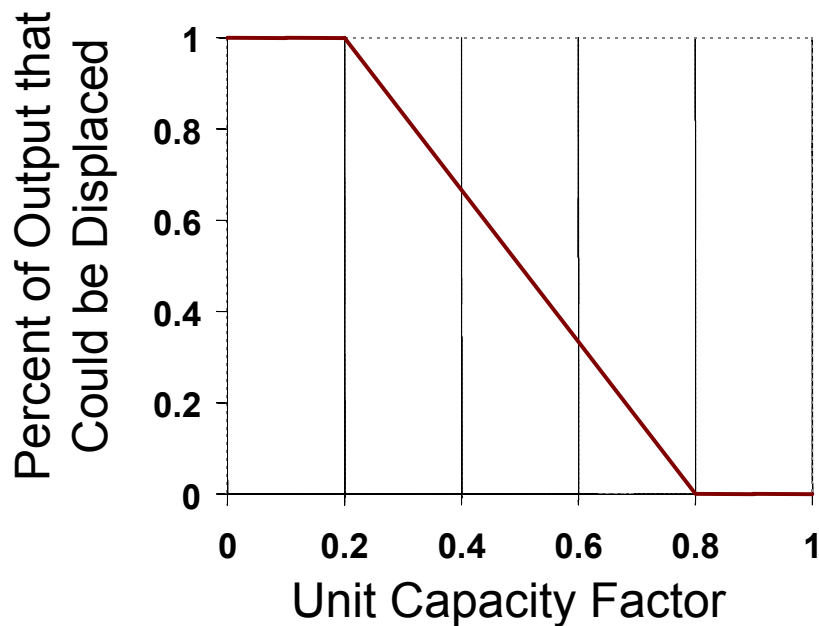


Pros and Cons of Matching

- Pro: It is transparent and amenable to review.
- Con: It is labor intensive and somewhat subjective – requires informed judgment.
- Con: It is based on a simplified conception of unit dispatch.

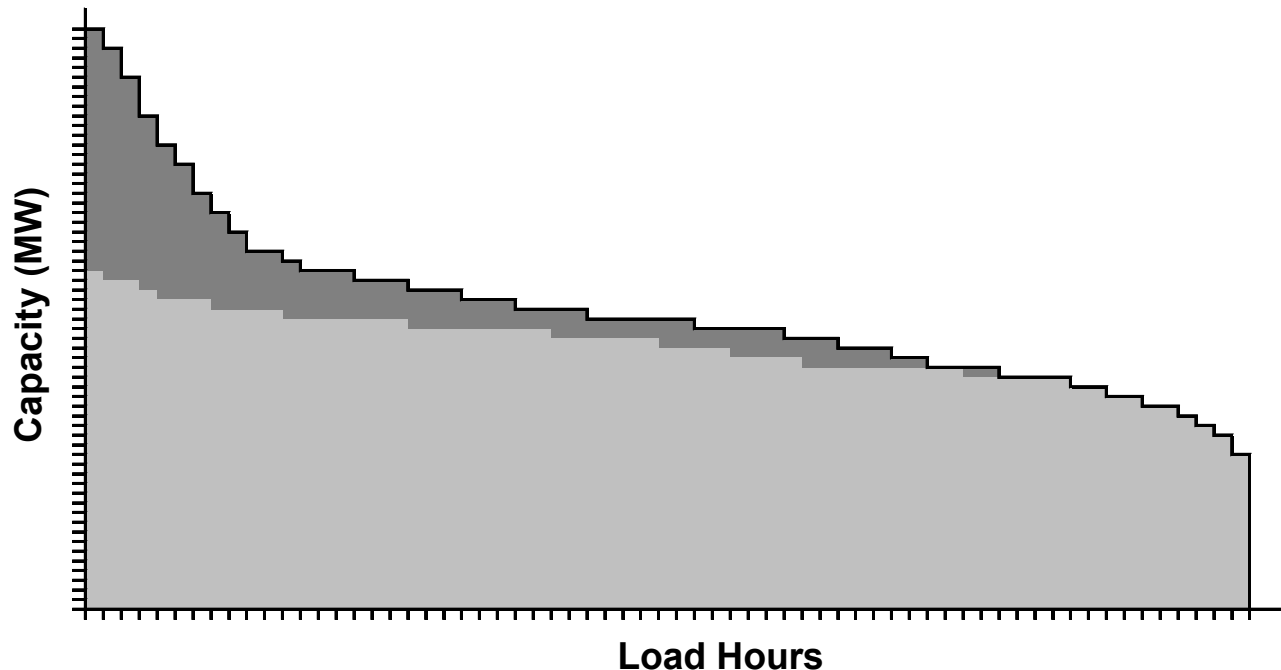
Using a Capacity Factor Rule

Another approach is to allocate reduced generation to units based on historical capacity factor.



Using a Capacity Factor Rule (2)

Make sure the rule describes the new technology well.



Application of a linear allocation rule on a load duration curve.

Pros and Cons of Using a CF Rule

- Pro: Relatively simple – do not need load data.
- Pro: Requires less informed judgment
- Caution: Must ensure that the rule is appropriate to the renewable or efficiency technology being assessed.
- Con: Assumes that historical capacity factor is a good measure of the extent to which a plant is subject to displacement.

Identifying “Load-Following” Units

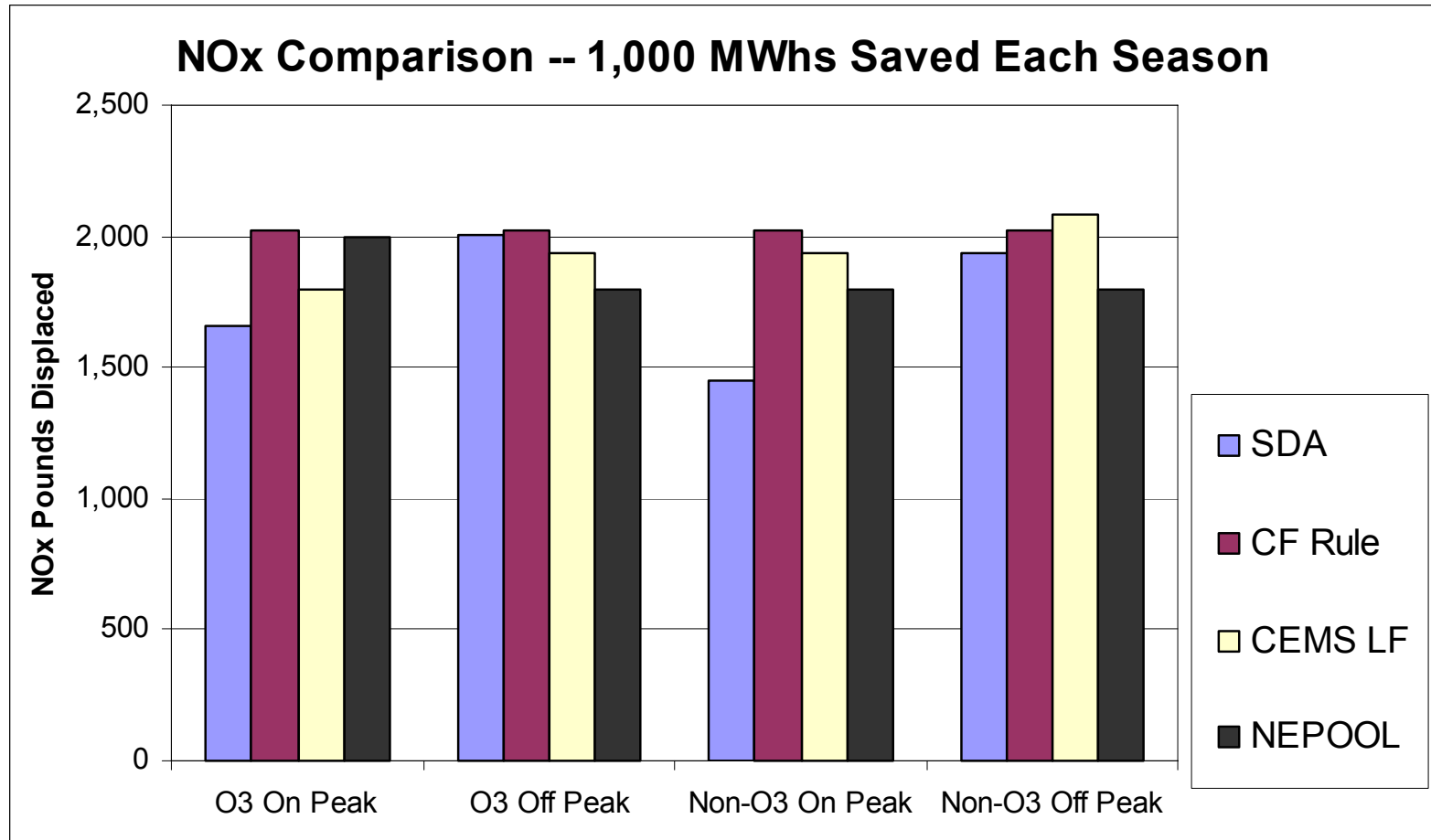
CEMS data can be merged with other data to identify load-following units in each hour.

- If a unit’s output in a given hour is correlated to load, it is defined as “load following.”
- If output does not change, or changes in inverse correlation to load, it is not “load following.”
- Hourly load-following emission rates can be averaged for any time period.

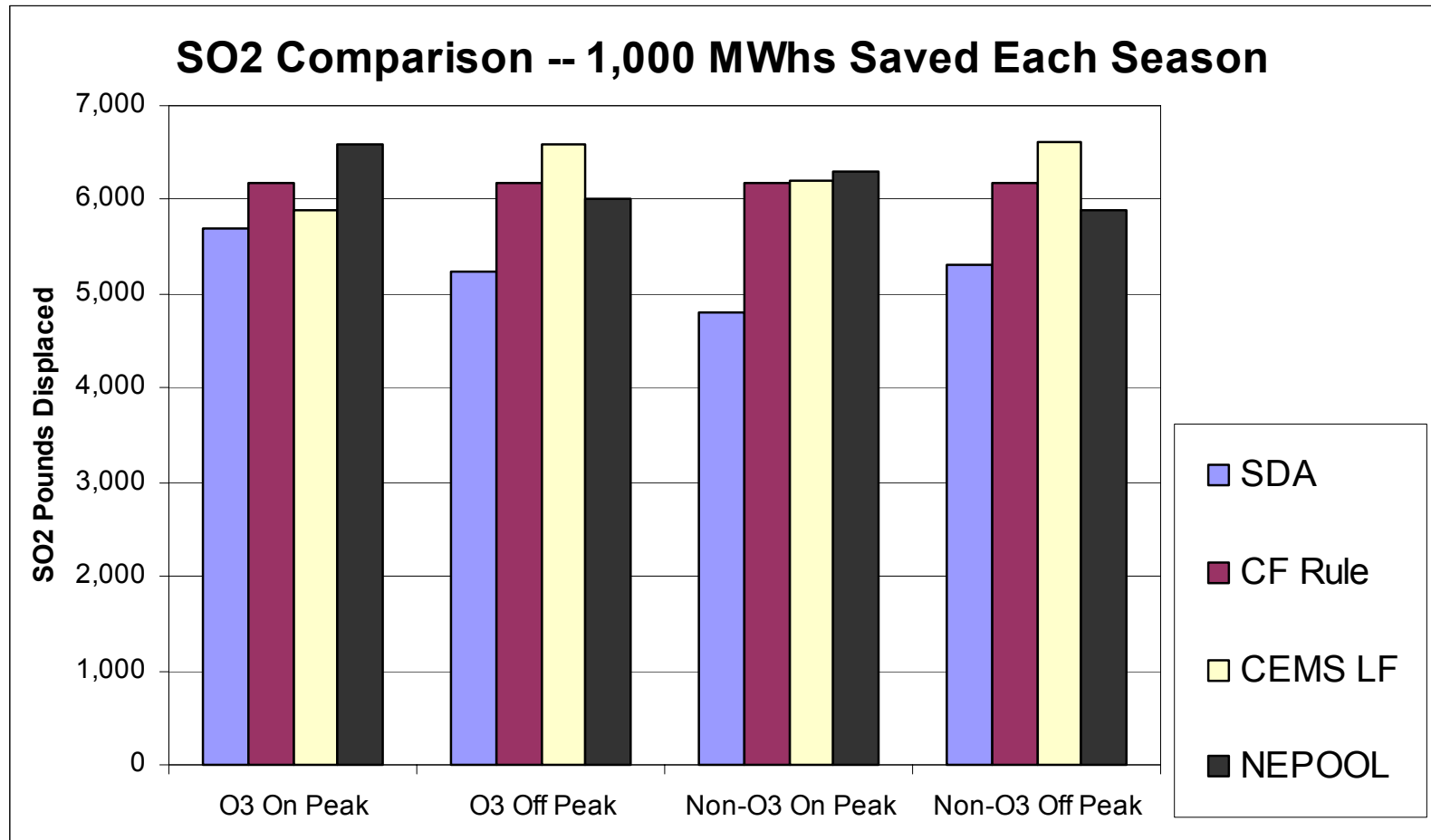
Pros and Cons of Identifying Load Following Units

- Pro: Based on data reflecting actual fossil plant operation. Captures the complexities of fossil unit dispatch.
- Pro: Very easy to use once database has been made.
- Con: Developing the database is very labor intensive.
- Con: Does not factor in hydro operation or energy transfers. In regions where significant amounts of hydro or imported energy follow load, this could reduce the accuracy of this method.

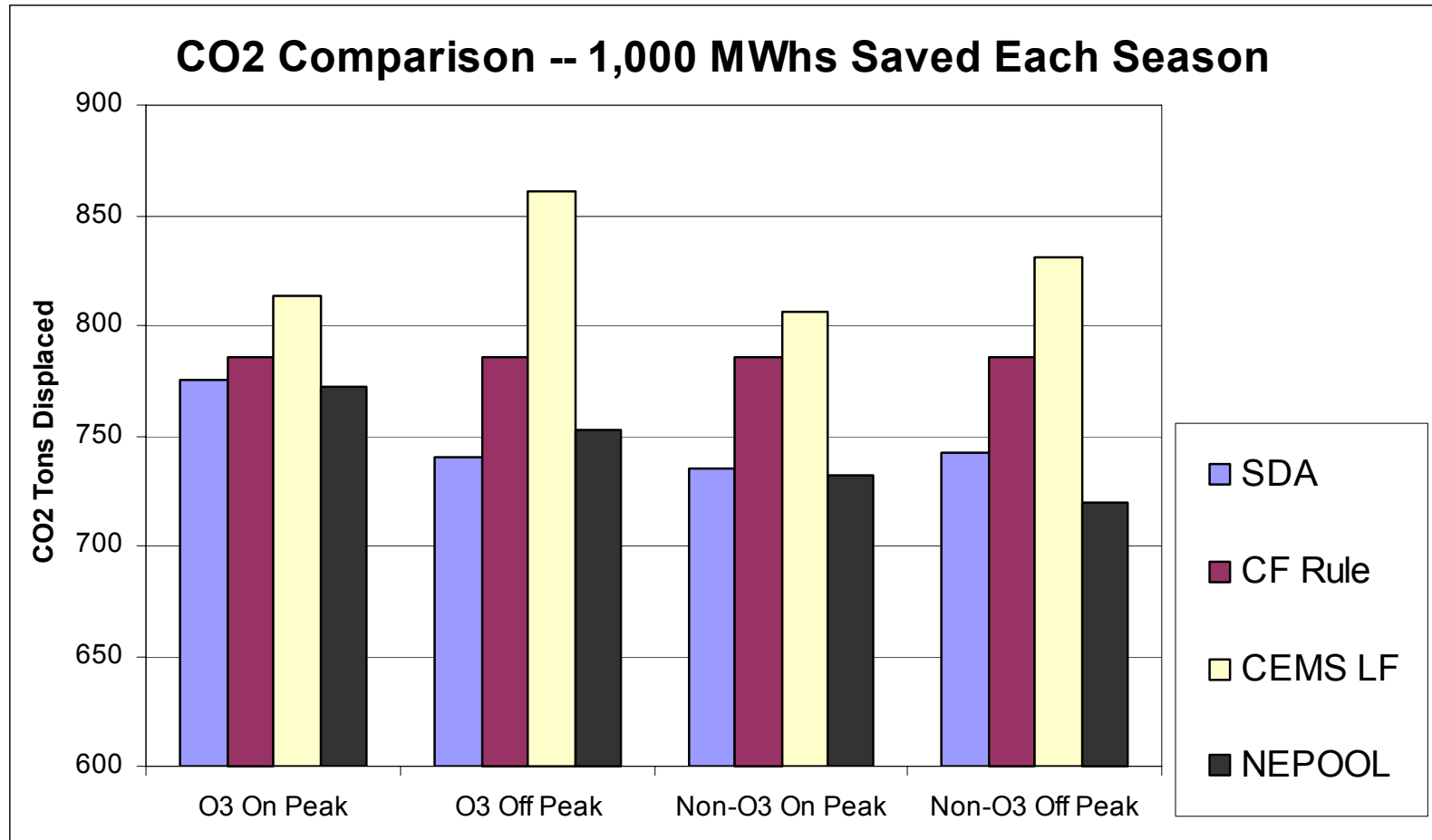
Quantitative Comparison – NO_x



Quantitative Comparison – SO₂



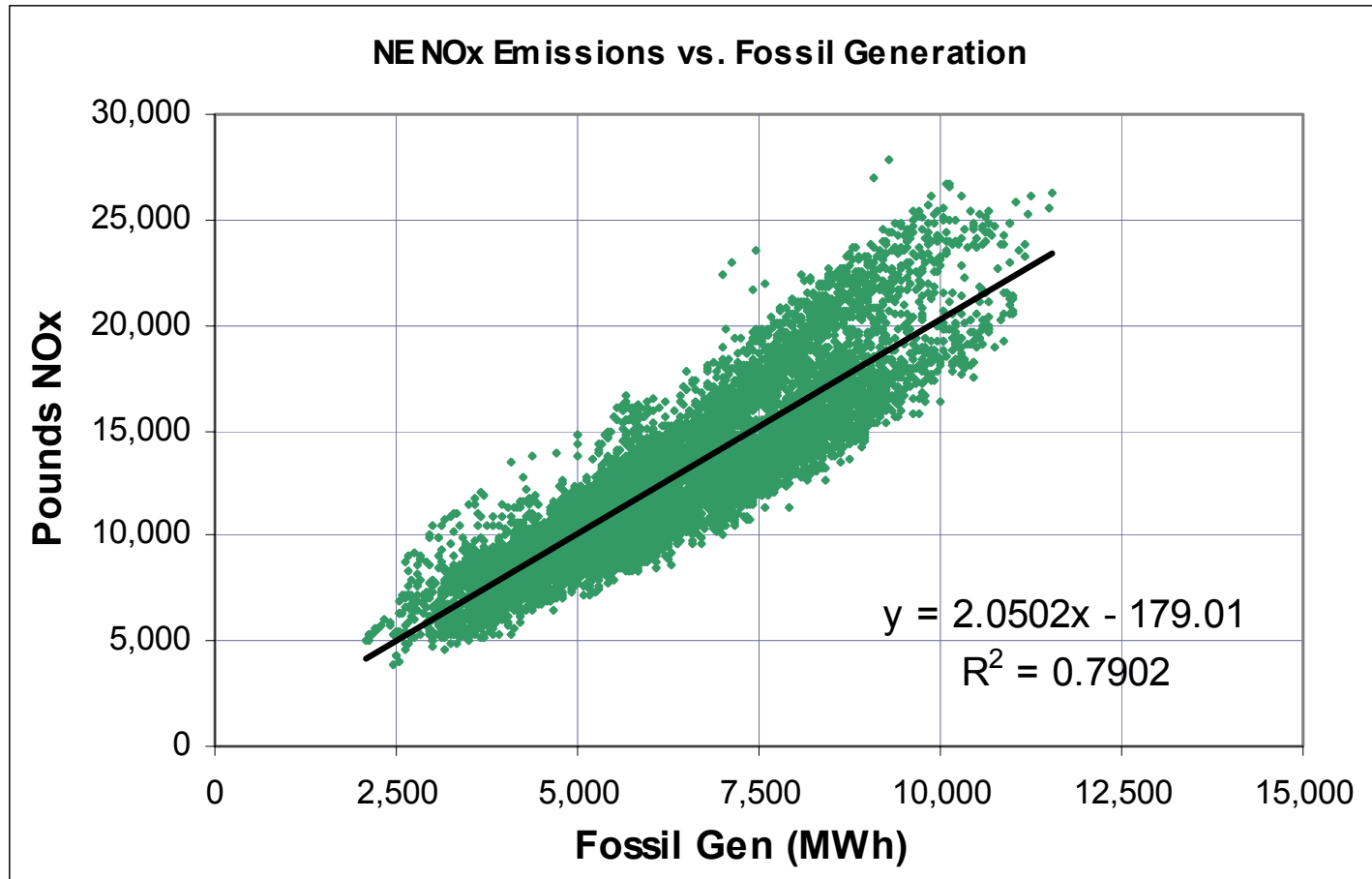
Quantitative Comparison – CO₂



Conclusions

- Matching appears to be sensitive to a region's particular generating mix. OK for rough calculations.
- The simplicity of using a CF rule is attractive. OK for rough calculations. More work needed to determine how accurate the method is.
- The use of CEMS data provides an empirical basis which the other methods do not have. More work is needed to determine how important hydro resources and imports are.
- It may be possible to develop a CEMS-based method that accounts for hydro and imports.
- The task of developing a CEMS database makes this method appropriate for a “centralized” approach (one database supports many calculations).

More On the CEMS Data



More On the CEMS Data

